THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 148.

THE CAPE CABLE.

THE decision of the Government with respect to the tenders for a submarine cable communication between England and her South African colonies is said to have been taken; and that of the Eastern Telegraph Company has been accepted.* The three principal tenders were an offer to lay a cable along any route which might be selected, an offer to connect Natal to Cape Comorin in India, via the Seychelles Islands, and, lastly, the Eastern Company's proposal to join Natal to Aden. At first sight it would seem that the second of these, though the most costly, is that to be preferred on Imperial grounds, since it links the South African Colonies to India, which is already connected to England by two routes, the Indo-European line and the Eastern Telegraph Company's cables. But the Indo-European line has the disadvantage of passing through Russian and Turkish territory: and Aden is a point equally connected to India and England. Hence there is, perhaps, little to draw between the Comorin and the Aden routes on the score of policy, while the Aden route is the least expensive to undertake.

The Eastern Telegraph Company have acted in conjunction with the Eastern Extension Telegraph Company, and their tender is said to be a joint one. They undertake to find the capital for the work and to work the cable as a private enterprise, supported by fixed subsidies from the home and colonial governments, making a total of, it is said, £50,000 for a period of twenty years in order to cover the estimated deficit of revenue. In return for this assistance the Company would give a rebate on Government messages. About 4,000 miles of cable will be required to extend the Red Sea Cable from Aden round Cape Guardafui along the east coast of Africa to Port Natal. The depth along the sea board is moderate, so that repairing will, as far as known, be easy. The cable will touch at the chief trading ports, including Zanzibar, Mozambique, Sofala, Delgoa Bay, and end at Durban, where the Cape land line system will be picked up. The cost of constructing the line is estimated at £1,000,000. There are about 2,000 miles of cable ready made, including 1,500 which had been prepared to duplicate the Australian line of the Eastern Extension Telegraph Company from Penang. This portion will be shipped at once to Durban and laid to Zanzibar. This half of the work will be accomplished by the middle of July if all goes well; and the remainder will probably be completed by October next.

The first line of telegraphic communication with the Cape Colonies is thus about to be realised; but the advisability of having an alternative route, though for the present lost sight of, is one which must not be forgot. A west coast cable or an overland line would best fulfil the purposes of such a route. Perhaps by the time the necessity for one becomes imperative, the difficulties of the unknown country between Zanzibar and Gondokoro may be found surmountable, and Mr. Siveright's project find more favour than it does at present. In the meantime, however, a part of that gentleman's scheme might, with advantage, be carried out, and Pretoria connected to Zanzibar by land-line. This plan would furnish an alternative route from Zanzibar to the colonies, which would be an important additional security.

* We hear, as we go to press, that the Government have not yet accepted the Eastern Company's offer, owing to the demand of the latter that the subsidy should be payable whether the cable be working or not.

NEW EXPERIMENTS UPON TELEPHONES WITHOUT DIAPHRAGMS.

By the COUNT DU MONCEL.

M. ADER, the author of an ingenious apparatus known under the name of the Electrophone, has undertaken a series of very interesting researches which not only justify to the full the theoretical ideas which I have put forth for over a year, upon the origin of sounds in ordinary telephones, but have also brought to light effects quite new and valuable to acoustical science.

M. Ader, in fact, has not only succeeded in making a telephone speak without a diaghragm, *but also in making it speak louder and with less change in the voice than ordinary telephones.* We cannot, therefore, now say that the sounds produced by the magnetic core of a telephone are so feeble that they only count for little or nothing in the effects produced, and that in all cases it is impossible to reproduce articulate sounds by them.

From the first, I have held that the reproduction of all sounds in the electro-magnetic telephone ought to be better in proportion as the magnetic organs were less in mass, because the magnetisations and the demagnetisations effect themselves more rapidly as that mass is feebler, lending themselves better to the reproduction of rapid vibrations, and I attributed the greater amplitude of sounds formed by the diaphragm of a Bell telephone as compared with those of the magnetic core, to the smaller mass of the diaphragm. I considered, besides, that the most important *rôle* filled by the diaphragm was to excite the magnetic energy of the core after the manner of an armature. The experiments of M. Ader have fully confirmed my previsions, and whilst a somewhat bulky cylinder

of iron or a magnetic core, does not reproduce speech under the influence of a current actuated by a speaking microphone, a simple iron wire helix can reproduce it easily, but on condition that one end is fastened to a board (as in fig. 1), and that the other end is free. In these conditions a helix B of a small number of spires can reproduce speech very distinctly, even when the spires are glued with shellac; and with a battery of six Leclanché elements, over a resistance of 10 kilometres (6¼ miles) of telegraph wire, without stopping the reproduction of speech.

Fig. 1.

But the most curious thing in this experiment is that we can *increase in an enormous ratio the sounds emitted by applying to the free end of the iron wire, and in simple contact with it, a mass of metal.* The sounds are then robbed of their metallic timbre and the voice takes its natural character. In order to hear it, it is not even necessary to apply the ear against the board, for it may be placed at from 10 to 15 centimetres from it without losing the words spoken. What is the cause of this reinforcement of sounds? It is difficult to say, in the actual condition of science, but if we admit that the magnetic core is shortened and lengthened by the momentary attractions among the magnetic molecules at the instant

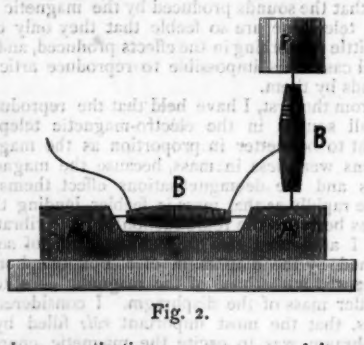


Fig. 2.

of their magnetisation, we may regard it as the result of shocks against a rigid matter incapable of following the molecular movements of the core by reason of the inertia of the metallic mass in contact with the latter. The closer the contact the better is the effect, and because of this, M. Ader solders the metallic mass to the free end of the iron wire. The effect is still more marked when to the two ends of the iron wire we solder metallic masses, but it is necessary that the two masses should not be connected by a substance susceptible of vibrating easily. The following experiment shows that this condition is essential.

If in a somewhat thick metal plate A we cut a notch E sufficiently large (as shown in fig. 2) to allow of the introduction of the magnetic core B, and fix the plate to a board, the core introduced into the notch will give out a confused and weak speech. On the contrary, if we fix the core by one end to the plate, and apply a metallic mass P to the other, the sounds will become very clear and strong. Is there, then, interference of sounds in the first case? It is certain that a magnetic core made of an iron wire stuck by the ends into a board of pine (as in fig. 3), hardly reproduces the sounds, whilst they become very distinct when we fix the iron wire to the board by one end only.

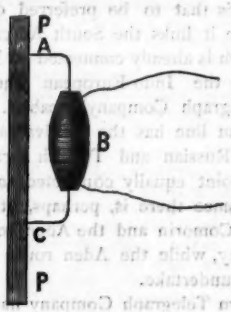


Fig. 3.

M. Ader has also experimented on the sounds produced by bobbins themselves. It has already been proved that bobbins traversed by interrupted currents may produce sounds, as MM. Rossetti, Canestrelli, Saul Roy, Buchin, Hughes, &c., have completely demonstrated; but they have not been able to hear distinct speech in that manner. M. Ader, in studying the phenomena, has been able to make certain that speech may be perfectly transmitted by this means on condition that the spires of the helix are loose and slightly pressed. When they are strongly pressed one against the other or sealed in shellac no sound can be produced; but it suffices to introduce inside the bobbin an iron wire, or needle, in order to render even words audible. M. Ader also finds that the voice can be rendered with a different timbre or pitch according to the degree of tension of the wire, a result due to the fundamental note of the wire blending with the voice. If this fundamental is stifled by pressing the wire between the fingers, the speech is of a dull quality like the voice and always the same whatever the tension of the wire. In fine, M. Ader has proved that we can also obtain speech by passing a curved wire of iron across a fixed bobbin, and in leaning the two ends against the membranes of two tight tambours (as in fig. 4). In these conditions speech can be heard some two or three metres from the apparatus, but

it is less distinct than in the former plans. The vibrations proceed, without doubt, in this case from the fact that under the influence of wave currents the wire tends to straighten itself more or less, as shown by the experiments of M. Guillemin in 1846.

Lastly, M. Ader has shown that we can also obtain speech from a helix whose spires are buried in shellac, when we place inside that helix another helix in circuit with the first. This effect may be attributed to the same cause, as in the case of the loose spires, to the reaction of the spires of the two helices upon each other.

In applying these different results to the construction of a telephone, M. Ader has succeeded in reproducing speech loud enough to be heard when the instrument is 20 centimetres (about 8 inches) from the ear. The simplest form consists in an iron wire fixed vertically by one end (as in fig 5) to a board of fir-wood A A, and soldered at the other end F^1 to a metallic weight P. On this wire F F^1, is fitted a helix of wire B, which is wound on a quill. When we place the ear behind the board speech is admirably reproduced; the voice is not so false as with the ordinary telephone. It can still be understood when 16 kilometres of telegraph line wire are put in circuit, and with 40 kilometres inserted it can

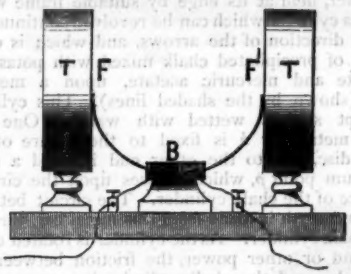


Fig. 4.

still be heard. Singing can be distinguished with 64 kilometres in circuit. Fig. 5 represents the apparatus in its natural dimensions. I will indicate in another article how this telephone can be practicably arranged. To finish with the question just now, I should report some experiments which I made myself relatively to these effects.

We should recollect that Mr. Spottiswoode was the first to publish the fact that speech could be obtained from a telephone without a diaphragm. The truth of this assertion has been doubted by most physicists. Nevertheless, it was confirmed by the experiments of MM. Warwick, Rossetti, Canestrelli, Weisandanger, Lloyd, Millar, &c. But the majority of those who wished to repeat the experiment could only get inarticulate sounds. I have stated the causes of this disagreement and have arrived at the following conclusion.

Generally, an ordinary telephone deprived of its diaphragm does not reproduce speech with the feeble currents of a Bell transmitter, or even with the powerful voltaic currents from a microphone. But if the microphone acts, and sends a current of six Leclanché elements through the primary of an induction coil, the secondary currents induced will reproduce speech, and the reproduction is more marked as the core of the coil is more highly magnetic and of smaller diameter.

By taking a fragment of watch spring, after having well magnetised it, and fixing it (as in fig. 6) by one end on a board, I obtain very distinct speech with a little helix of No. 30 wire, under the influence of a battery of six Leclanché elements acting on the induction coil of a singing condenser; but the helix must be short and placed on the fixed part of the spring. When placed on the free extremity we hear

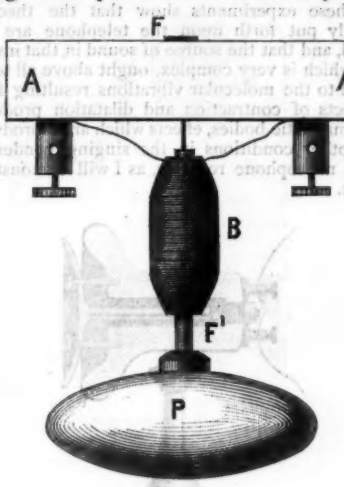


Fig. 5.

no sound, and the reproduction of speech was not obtained when the bobbin was placed in the middle of the plate. This circumstance shows that all arrangements which favour the vibration and free movement of the magnetic core is favourable to the electro-magnetic production of sounds. The insertion of 64 kilometres of line wire in circuit did not forbid speech. Speech could be equally well

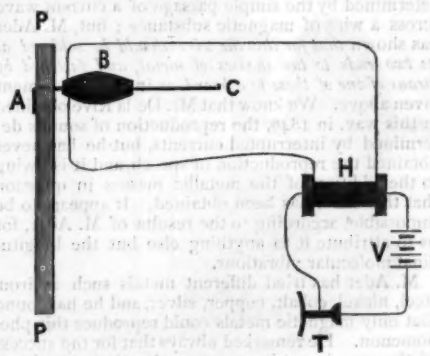


Fig. 6.

transmitted in employing the direct current from the battery; but the interposition of a resistance of 8 kilometres in circuit rendered it so feeble that it could just be heard.

In these different experiments the microphonic transmitter employed was that which M. Ader had combined with his electrophone, and which is illustrated in fig. 7, but the carbon transmitter of Mr. Edison gave the best results. In that of M. Ader there are two *o* and *c* carbons in contact and one speaks before the cup on the right of the figure. On inclining the apparatus to 45°, the variations of pressure between the two carbons determined by the vibrations of the voice suffice to transmit speech.

All these experiments show that the theories originally put forth upon the telephone are not justified, and that the source of sound in that instrument, which is very complex, ought above all to be referred to the molecular vibrations resulting from the effects of contraction and dilatation produced within magnetic bodies, effects which are reproduced under other conditions in the singing condenser, and the microphone receiver, as I will demonstrate later on.

Fig. 7.

The reproduction of speech can also be obtained, but in a far less interesting manner, by vibrations determined by the simple passage of a current wave across a wire of magnetic substance; but, M. Ader has shown *that for this the wire should be soldered at its two ends to two masses of metal, and fastened by means of one of these to a board*, as in the experiment given above. We know that Mr. De la Rive obtained in this way, in 1846, the reproduction of sounds determined by interrupted currents, but he has never obtained the reproduction of speech, and it is owing to the addition of the metallic masses in question that this effect has been obtained. It appears to be impossible, according to the results of M. Ader, for us to attribute it to anything else but the longitudinal molecular vibrations.

M. Ader has tried different metals such as iron, steel, nickel, cobalt, copper, silver, and he has found that only magnetic metals could reproduce this phenomenon. He remarked always that for the success of the experiment it was necessary that the circuit in which the wire was placed should have a very small resistance, and that the battery should be powerful in respect of quantity. A single bichromate of potash element serves the purpose.

In fine, the effects which favour the amplification of sounds in electro-magnetic systems, favour it equally in systems which are simply electro-dynamic, and both depend on the same vibratory cause in relation with the magnetisations and demagnetisations effected inside the sonorous magnetic body.*

EDISON'S NEW TELEPHONE RECEIVER.

THE new telephone receiver of Mr. Edison is, undoubtedly, the greatest step in advance which has been made towards rendering the telephone a loud-speaking instrument. It is no longer the "still small voice" which we have to listen for intently, as the new receiver reproduces the words spoken into the distant transmitter in distinctly audible tones. The sounds, in fact, are as loud and clear as are those received through a short speaking-tube.

The new receiver in principle is based upon the electro-motograph, an invention of Mr. Edison's, which was described in the number of the JOURNAL for Sept. 15th of last year, and is constructed as follows:—

In fig. 1, *d*, *d*, is a mica disc about four inches in diameter, held at its edge by suitable frame work. *c*, *c*, is a cylinder which can be revolved continuously in the direction of the arrows, and which is composed of precipitated chalk mixed with potassium hydrate and mercuric acetate, upon a metallic axle (shown by the shaded lines). This cylinder is kept slightly wetted with water. One end of a metal bar *b* is fixed to the centre of the mica disc, and to the other end is fixed a small platinum point *p*, which presses upon the circumference of the chalk cylinder. The circuit between line and earth is made from this metal bar, through the chalk cylinder. As the cylinder is rotated either by hand or other power, the friction between the metal bar and the chalk cylinder is very considerable, and the diaphragm is drawn or bowed outward toward the cylinder. This operation is purely mechanical and local. When the electric waves are transmitted from the distant station by the speaker (who uses Edison's carbon transmitter connected in circuit with the induction coil A in the usual manner) over the wire to the receiver, each wave as it passes through the chalk cylinder effects by electro-chemical decomposition more or less neutralisation of the friction between the bar and the cylinder, according as the wave may be a strong or weak one. The resultant effect of each wave is the freeing of the diaphragm, permitting it to regain its normal position. Thus a series of electric waves, with the alternate space between, effects a vibration of the diaphragm in perfect accord with the voice of the speaker, the action being solely electrical and chemical. The element of time is not a factor as in the electro-magnetic instrument of Professor Bell, where, as is well known, a perceptible degree of time is requisite for a charge and discharge. In this new telephone apparatus Edison dispenses entirely with the electro-magnet, heretofore used in all telephone receivers, substituting the above electro-

* Count Du Moncel has kindly promised us some further observations on this interesting subject.

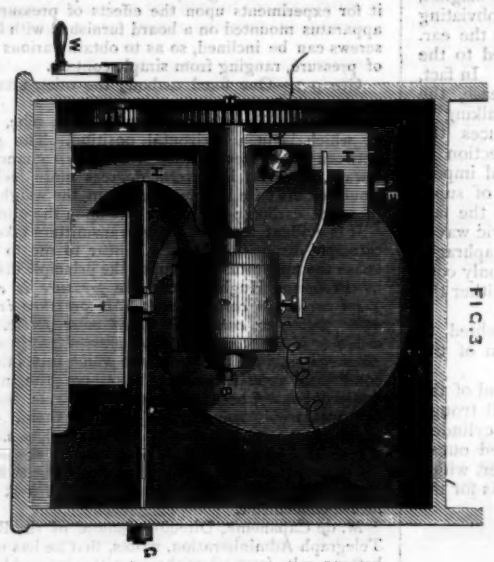


FIG. 3.

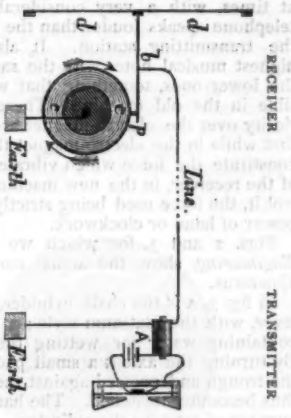


FIG. 1.

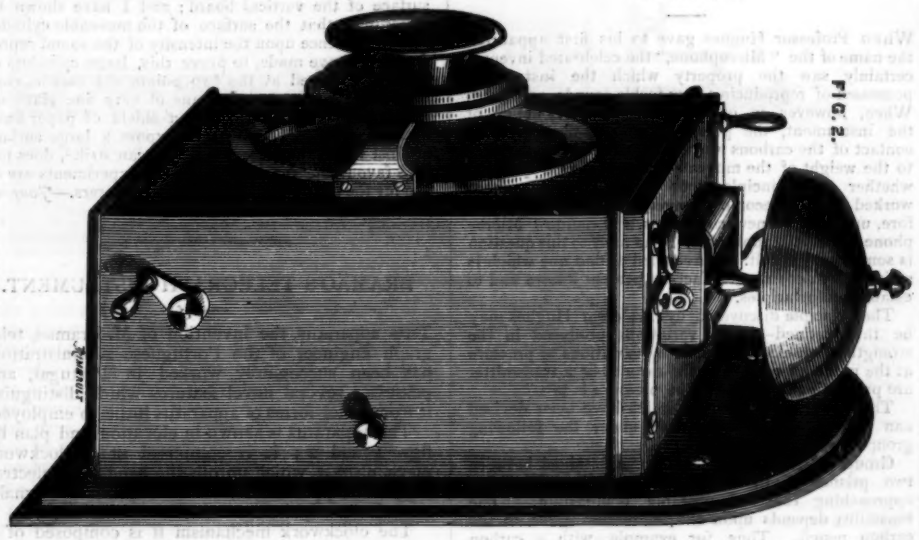


FIG. 2.

chemical principle. This, by its greater delicacy and power, is made to vibrate a very much larger diaphragm than is possible with the electro-magnet, thus giving greater volume of sound and obviating the necessity for holding the telephone to the ear. By it the voice of the speaker is transmitted to the distant station without the loss of volume. In fact, at times, with a very considerable increase, the telephone speaks louder than the person talking at the transmitting station. It also produces the highest musical notes with the same perfection as the lower ones, something that was found impossible in the old machine. These points of superiority over the electro-magnet are due to the fact that while in the electro-magnet the electric waves constitute the force which vibrates the diaphragm of the receiver, in the new machine they only control it, the force used being strictly local, either the power of hand or clockwork.

Figs. 2 and 3, for which we are indebted to *Engineering*, show the actual construction of the apparatus.

In fig. 3, A is the chalk cylinder, C the end of the lever, with the platinum style; T is a small trough containing water for wetting the chalk cylinder. By turning the axle G a small pad is raised out of the trough and pressed against the cylinder, which thus becomes moistened. The handle, W, is for the purpose of rotating the cylinder.

NOTE ON THE DISTINCTIVE FEATURES OF THE MICROPHONE.

By M. NAVEZ.

WHEN Professor Hughes gave to his first apparatus the name of the "Microphone," the celebrated inventor certainly saw the property which the instrument possessed of reproducing very feeble sounds, amplified. When, however, in order to regulate the action of the instrument, the pressure between the points of contact of the carbons was augmented beyond that due to the weight of the moveable carbon, it is a question whether the principle upon which the instrument worked did not become changed, and whether, therefore, under these new conditions, the name "Microphone" was still applicable. The reply to this question is somewhat difficult. I have tried to find one which is satisfactory according to facts at present known and to established principles.

The principle discovered by Professor Hughes may be thus defined—"The variations produced in the strength of an electric current by variations of pressure at the points of contact of the carbons of a transmitter are proportionally great as the pressure is less."

The different microphones which have been devised can be, almost all, comprised under the following groups:—

Group 1.—A pencil of carbon maintained between two prisms of the same material, in a position approaching that of unstable equilibrium. The sensibility depends upon the inclination given to the carbon pencil. Thus, for example, with a carbon pencil 50 millimetres long and 1 millimetre out of perpendicular, the initial pressure would be reduced to $\frac{1}{100}$th of the weight of the pencil.

Group 2.—One carbon fixed, the other suspended by means of a very fine metallic wire allowing the passage of the electric current. It is this arrangement which I devised, immediately after the publication of the invention of Professor Hughes, with the object of employing it for experiments upon the effects of pressure. The apparatus mounted on a board furnished with levelling screws can be inclined, so as to obtain various degrees of pressure, ranging from simple contact.

Group 3.—One fixed carbon; the other attached to a lever.

Group 4.—Pieces of carbon shut in a tube, the axis of which is in a horizontal position. The pressure between the pieces of carbon is left to chance; it is always, however, in several degrees more feeble than would be the case if it resulted from the weight of the pieces of carbon pressing the one upon the other.

It is evident that all these transmitters take up the principal dispositions which appear to me to characterise the apparatus based upon the principle discovered by Professor Hughes: 1st. *The pressure is exercised from carbon to carbon;* 2nd. *This pressure is always more feeble, or can be rendered more feeble, than it would be if the moveable carbon pressed freely upon the fixed carbon.* All the apparatus which fulfils these two conditions appear to me to deserve the name of "Microphones," because, according to rule, they could transmit feeble sounds and amplify them. As for ordinary speech, up to the present it has not been transmitted without considerable loss of intensity; but microphones are progressing, and I think that it is in this category of apparatus that we must look for the future transmitter.

M. de Capanema, Director-General of the Brazilian Telegraph Administration, writes, that he has obtained better results from microphones with a moveable pencil, by speaking against the board on the opposite side to that on which the microphone is fixed. This observation confirms those facts discovered by Professor Hughes and myself. Professor Hughes has observed that the effect of the microphone increases with the surface of the vertical board; and I have shown by experiment that the surface of the moveable cylinder has no influence upon the intensity of the sound reproduced. I have made, to prove this, large cylinders of elder pith, tipped at the two points with carbon, connection being made by means of very fine platinum wire. I have also shown that a shield of paper fixed on the carbon pencil, so as to expose a large surface against which the sonorous waves can strike, does not give favourable results. All these experiments are of use for the future guidance of experimenters.—*Journal Telegraphique.*

BRAMÃO'S TELEGRAPH INSTRUMENT.

THIS apparatus, the invention of M. Bramão, telegraph engineer of the Portuguese administration, has been successfully worked in Portugal, and possesses several novel features which distinguish it from other forms of apparatus hitherto employed.

The apparatus is shown in elevation and plan by figs. 1 and 2; it is composed of a clockwork mechanism H, which unrolls the band of an electro-magnetic apparatus E, which reproduces signals, and of a manipulator M which transmits them.

The clockwork mechanism H is composed of a motor, a regulator, and three intermediate gearing wheels. In figs. 1 and 2 it may be seen that the axis or arbor of the second mover passes through the plate *a*, and supports externally the roller *b*, which, aided by the roller b^1, carries the band

through at an average speed of 50 centimetres per minute. The paper is wound on the wheel R. After leaving this wheel the paper band passes through the opening *c d* formed in the base of the apparatus, rises to the plate *e*, and passes between the rollers *b* b^1.

The plate *e* acted upon by the spring e^1 presses the band lightly against the lower surface of the piece *f*, and places it on the receiving plane; the force of the spring e^1 is determined by the screw e^{11}. The lever *g* may occupy two positions, one raised and the other lowered; in the latter position it stops the clockwork mechanism and removes the band from the receiving plane simultaneously.

The electro-magnetic apparatus E is composed of an ordinary electro-magnet and a strong magnetic bar bent twice at right angles.

FIG. 1.

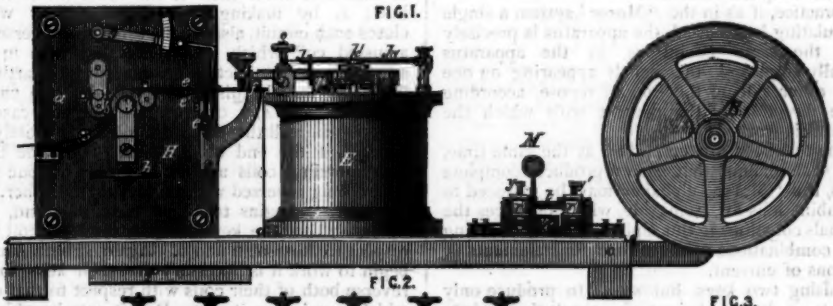
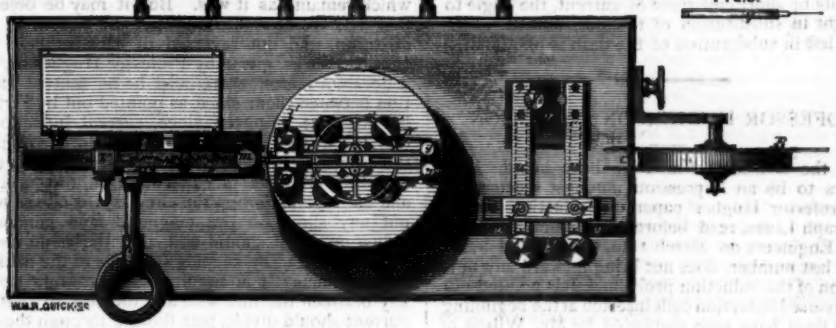


FIG. 2.

FIG. 3.



The poles *n s* of the magnet and the poles *p* p^1 of the electro-magnet are in the same plane, and are respectively placed at the extremities of two perpendicular diameters. These poles, divided in two in the direction of the circumference, freely contain the armature n^1 n^1, s^1 s^1 composed of two semicircles of soft iron n^1 n^1, s^1 s^1; these two semicircles are united by a copper cross I to an axis or arbor 2 in the centre of the apparatus.

The levers *j* j^1, figs. 1 and 2, are moveable in their axis *j* j^{111}, and by yielding to the action of springs j^{iv} j^v acting in contrary directions transmit, each on its own side, the action of these springs to the appendage *k* of the armature; this action is limited on both sides by the piece b^1, which by its lateral play, enables it to cause the direction which the levers *j* j^1 give to the appendage *k* to coincide with the position of repose of the armature. In case this does not happen this position corresponds to the moment when the extremities n^1 s^1, n^1 s^1 are arranged identically in relation to the poles *p* p^1 of the electro-magnet. The screws *l* l^1, at equal distances from the appendages *k*, limit each in its own direction the full movement of the armature. The appendage *k* is terminated by a holder or claw which supports the inker *m*, formed of a funnel-shaped cap, in which printing ink is poured. The buttons or knobs *o* o^1 partly regulate the tension of the contrary springs j^{iv} j^v.

The manipulator or manipulating piece M, figs. 1 and 2, comprises two flexible springs *r* r^1, four contact pieces *t* t^1, u^{11} u^{111}, a commutator V furnished with two springs *u* u^1, and a pin or peg v^1.

The ends of the springs *u* u^1 of the commutator press against two insulated pieces which are fixed on the under surfaces of the blades *r* r^1.

The two blades are ordinarily in contact with the screws *x* x^1 of the piece *t*, and are consequently removed from the contacts of the piece t^1; the same separation also exists between the extremities of the springs *u* u^1 and the contacts of the pieces u^{11} u^{111}.

When the spring *r* is pressed down the contacts of *r* with t^1 and of *u* with u^{11} are simultaneously established; when the blade r^1 is lowered the contacts of r^1 with t^1 and of u^1 with u^{111} are established in the same manner.

The screws *x* x^1, in constituting the contacts o the piece *t* also serve to regulate the full movements of the springs *r* r^1. The pin or peg v serves to put the commutator v into metalli

chemical principle. This, by its greater delicacy and power, is made to vibrate a very much larger diaphragm than is possible with the electro-magnet, thus giving greater volume of sound and obviating the necessity for holding the telephone to the ear. By it the voice of the speaker is transmitted to the distant station without the loss of volume. In fact, at times, with a very considerable increase, the telephone speaks louder than the person talking at the transmitting station. It also produces the highest musical notes with the same perfection as the lower ones, something that was found impossible in the old machine. These points of superiority over the electro-magnet are due to the fact that while in the electro-magnet the electric waves constitute the force which vibrates the diaphragm of the receiver, in the new machine they only control it, the force used being strictly local, either the power of hand or clockwork.

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By M. NAVEZ.

WHEN Professor Hughes gave to his first apparatus the name of the "Microphone," the celebrated inventor certainly saw the property which the instrument possessed of reproducing very feeble sounds, amplified. When, however, in order to regulate the action of the instrument, the pressure between the points of contact of the carbons was augmented beyond that due to the weight of the moveable carbon, it is a question whether the principle upon which the instrument worked did not become changed, and whether, therefore, under these new conditions, the name "Microphone" was still applicable. The reply to this question is somewhat difficult. I have tried to find one which is satisfactory according to facts at present known and to established principles.

The principle discovered by Professor Hughes may be thus defined—"The variations produced in the strength of an electric current by variations of pressure at the points of contact of the carbons of a transmitter are proportionally great as the pressure is less."

The different microphones which have been devised can be, almost all, comprised under the following groups:—

Group 1.—A pencil of carbon maintained between two prisms of the same material, in a position approaching that of unstable equilibrium. The sensibility depends upon the inclination given to the carbon pencil. Thus, for example, with a carbon pencil 50 millimetres long and 1 millimetre out of perpendicular, the initial pressure would be reduced to $\frac{1}{100}$th of the weight of the pencil.

Group 2.—One carbon fixed, the other suspended by means of a very fine metallic wire allowing the passage of the electric current. It is this arrangement which I devised, immediately after the publication of the invention of Professor Hughes, with the object of employing it for experiments upon the effects of pressure. The apparatus mounted on a board furnished with levelling screws can be inclined, so as to obtain various degrees of pressure, ranging from simple contact.

Group 3.—One fixed carbon; the other attached to a lever.

Group 4.—Pieces of carbon shut in a tube, the axis of which is in a horizontal position. The pressure between the pieces of carbon is left to chance; it is always, however, in several degrees more feeble than would be the case if it resulted from the weight of the pieces of carbon pressing the one upon the other.

It is evident that all these transmitters take up the principal dispositions which appear to me to characterise the apparatus based upon the principle discovered by Professor Hughes: 1st. *The pressure is exercised from carbon to carbon;* 2nd. *This pressure is always more feeble, or can be rendered more feeble, than it would be if the moveable carbon pressed freely upon the fixed carbon.* All the apparatus which fulfils these two conditions appear to me to deserve the name of "Microphones," because, according to rule, they could transmit feeble sounds and amplify them. As for ordinary speech, up to the present it has not been transmitted without considerable loss of intensity; but microphones are progressing, and I think that it is in this category of apparatus that we must look for the future transmitter.

M. de Capanema, Director-General of the Brazilian Telegraph Administration, writes, that he has obtained better results from microphones with a moveable pencil, by speaking against the board on the opposite side to that on which the microphone is fixed. This observation confirms those facts discovered by Professor Hughes and myself. Professor Hughes has observed that the effect of the microphone increases with the surface of the vertical board; and I have shown by experiment that the surface of the moveable cylinder has no influence upon the intensity of the sound reproduced. I have made, to prove this, large cylinders of elder pith, tipped at the two points with carbon, connection being made by means of very fine platinum wire. I have also shown that a shield of paper fixed on the carbon pencil, so as to expose a large surface against which the sonorous waves can strike, does not give favourable results. All these experiments are of use for the future guidance of experimenters.—*Journal Telegraphique.*

BRAMÃO'S TELEGRAPH INSTRUMENT.

THIS apparatus, the invention of M. Bramão, telegraph engineer of the Portuguese administration, has been successfully worked in Portugal, and possesses several novel features which distinguish it from other forms of apparatus hitherto employed.

The apparatus is shown in elevation and plan by figs. 1 and 2; it is composed of a clockwork mechanism H, which unrolls the band of an electro-magnetic apparatus E, which reproduces signals, and of a manipulator M which transmits them.

The clockwork mechanism H is composed of a motor, a regulator, and three intermediate gearing wheels. In figs. 1 and 2 it may be seen that the axis or arbor of the second mover passes through the plate *a*, and supports externally the roller *b*, which, aided by the roller b^1, carries the band

through at an average speed of 50 centimetres per minute. The paper is wound on the wheel R. After leaving this wheel the paper band passes through the opening *c d* formed in the base of the apparatus, rises to the plate *e*, and passes between the rollers *b b*¹.

The plate *e* acted upon by the spring *e*¹ presses the band lightly against the lower surface of the piece *f*, and places it on the receiving plane; the force of the spring *e*¹ is determined by the screw *e*¹¹. The lever *g* may occupy two positions, one raised and the other lowered; in the latter position it stops the clockwork mechanism and removes the band from the receiving plane simultaneously.

The electro-magnetic apparatus E is composed of an ordinary electro-magnet and a strong magnetic bar bent twice at right angles.

FIG. 1.

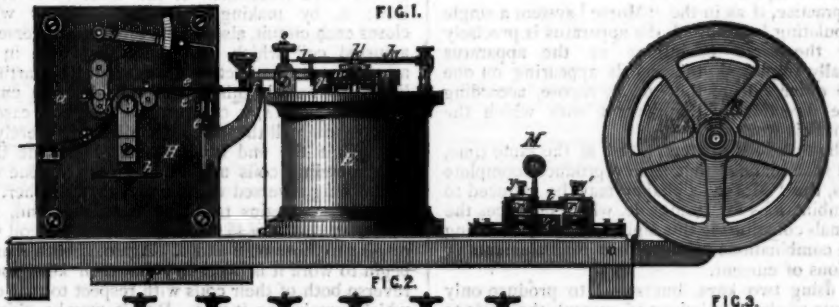
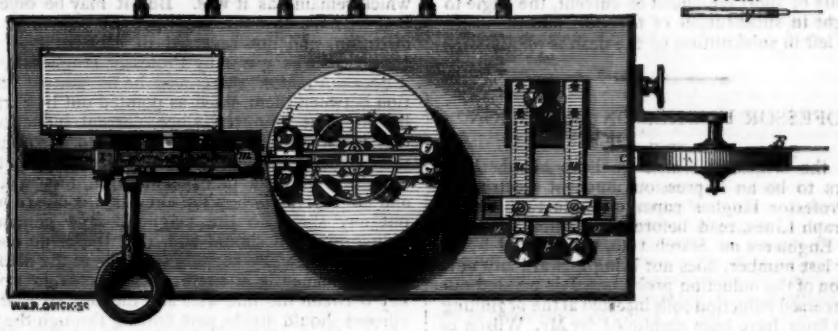


FIG. 2.

FIG. 3.



The poles *n s* of the magnet and the poles *p p*¹ of the electro-magnet are in the same plane, and are respectively placed at the extremities of two perpendicular diameters. These poles, divided in two in the direction of the circumference, freely contain the armature *n*¹ *n*¹, *s*¹ *s*¹ composed of two semicircles of soft iron *n*¹ *n*¹, *s*¹ *s*¹; these two semicircles are united by a copper cross 1 to an axis or arbor 2 in the centre of the apparatus.

The levers *j j*¹, figs. 1 and 2, are moveable in their axis *j j*¹¹¹, and by yielding to the action of springs *j*ᵛ· *j*ᵛ· acting in contrary directions transmit, each on its own side, the action of these springs to the appendage *k* of the armature; this action is limited on both sides by the piece *k*¹, which by its lateral play, enables it to cause the direction which the levers *j j*¹ give to the appendage *k* to coincide with the position of repose of the armature. In case this does not happen this position corresponds to the moment when the extremities *n*¹ *s*¹, *n*¹ *s*¹ are arranged identically in relation to the poles *p p*¹ of the electro-magnet. The screws *l l*¹, at equal distances from the appendages *k*, limit each in its own direction the full movement of the armature. The appendage *k* is terminated by a holder or claw which supports the inker *m*, formed of a funnel-shaped cap, in which printing ink is poured. The buttons or knobs *o o*¹ partly regulate the tension of the contrary springs *j*ᵛ· *j*ᵛ·.

The manipulator or manipulating piece M, figs. 1 and 2, comprises two flexible springs *r r*¹, four contact pieces *t t*¹, *u*¹¹ *u*¹¹¹, a commutator V furnished with two springs *u u*¹, and a pin or peg v¹.

The ends of the springs *u u*¹ of the commutator press against two insulated pieces which are fixed on the under surfaces of the blades *r r*¹.

The two blades are ordinarily in contact with the screws *x x*¹ of the piece *t*, and are consequently removed from the contacts of the piece *t*¹; the same separation also exists between the extremities of the springs *u u*¹ and the contacts of the pieces *u*¹¹ *u*¹¹¹.

When the spring *r* is pressed down the contacts of *r* with *t*¹ and of *u* with *u*¹¹ are simultaneously established; when the blade *r*¹ is lowered the contacts of *r*¹ with *t*¹ and of *u*¹ with *u*¹¹¹ are established in the same manner.

The screws *x x*¹, in constituting the contacts o the piece *t* also serve to regulate the full movements of the springs *r r*¹. The pin or peg v serves to put the commutator V into metalli

connection with the springs r or with the spring r^1, according to the side on which it is placed.

Fig. 3 is a small pricker for clearing out the orifice in the ink cup should it become clogged from disuse.

The following is the action of the apparatus:—By supposing the regulator of the clockwork mechanism and the plate e free from the action of the lever g, which occurs when the latter is raised, the band unrolls uniformly in the receiving plane, and receives a continuous line or stroke from the very fine orifice of the inker m.

According to the movements of the armature, and consequently the displacements of the inker, this stroke or line is converted through the influence of the currents into angles to the right and bars or lines to the left; the signals produced in fact are very similar to those obtained by means of Thomson's Siphon Recorder.

In practice, if as in the "Morse' system a single manipulating key is used, the apparatus is precisely under the same conditions as the apparatus generally employed, the signals appearing on one or the other side of the line of repose, according to the direction of the current with which the apparatus is worked.

If the two keys are employed at the same time, but in such manner that each reproduces complete signals, the "Morse" alphabet may be reduced to 30 combinations for each side, which produces the 60 signals constituting this alphabet, without having to use combinations of more than four elements or emissions of current.

By using two keys, but so as to produce only elements of short emissions of current, the angle to the right in substitution of the dot, and the angle to the left in substitution of the dash is obtained.

PROFESSOR HUGHES ON INDUCTION.

FROM the criticisms which we have heard, there appears to be an impression amongst electricians that Professor Hughes' paper on Induction on Air Telegraph Lines, read before the Society of Telegraph Engineers on March 12th, and treated by us in our last number, does not bring forward any new solution of the induction problem. It is pointed out that reversed induction coils inserted at the beginning of two lines have been employed by Mr. Wilson of Chicago, and Mr. Little of New York, as well as by other electricians. But there is an important essential difference between these earlier methods and that of Professor Hughes, which a fuller study of his paper than we had time to give it before our last issue, has made clear to us. Professor Hughes' researches were of that kind which are not grasped at once from merely hearing them read over; and it is matter for regret that a special night was not set apart by the Society for the full discussion of them after members had had time to study the printed paper thoroughly. As it is, we fear that many of those present at the meeting did not understand the results submitted to them, and not understanding them, did not, of course, appreciate them. Hence it has come to pass that one of the most important and original contributions of the winter has been hurried over in neglect.

The plan of connecting reversed coils in circuit with the wires of the line, and adjusting their mutual induction so as to balance the mutual induction of the wires, as used by Mr. Wilson, is sufficient for a two wire line; but when three or more wires have to be balanced it fails. To apply it to ten wires, for example, as many as forty-five coils would be required and even then the balance would be imperfect. This is due to the necessity of making the balance so that any number of the ten wires may, in actual working, become primaries to the others as secondaries; in short, that all sorts of combinations of the inductive influence may take place.

Now, Professor Hughes dispenses with the need of so many coils, 1, by making the length of each coil proportionate to the length (and resistance) of the actual wire it stands for, and its distance from each of the other coils proportionate to the distance of that wire from each of the other wires of the line; 2, by making the signalling key which closes each circuit, also by the same act, reverse the adjusted coil which represents that wire in the arrangement of induction coils forming the artificial line. To explain this, let us consider one end of the three wires A, B, C, in order. The first case we have is when all the three are silent or merely receiving at the end in question. Here the three corresponding coils are all in circuit in one way, some being reversed with respect to the other. If, however, A begins to signal from one end, it is necessary that the key should reverse A's coil with respect to those of B and C. Again, if both A and B begin to work it is necessary that their keys should reverse both of their coils with respect to that of C, which remains as it was. But, it may be objected that we have now the coils of A and B both in one direction, and not reversed to each other. The answer to this, given by Professor Hughes, is, that it does not matter, there need be no mutual induction between them, since, as pointed out by Faraday in 1832, but forgotten since, current induction is due to changes in the magnetic field surrounding the current. If, then, the simultaneous currents of A and B were made of equal strength, they will rise and fall together when the circuits are closed without any shock to the magnetic field generating induction. We should add, that the same results may be secured by keeping the coils of the artificial line permanently in circuit and connecting up the key between the line wire and the coil, so that the current should divide, part flowing through the wire to the distant station and part flowing in the reverse direction through the coil to earth.

A NEW KIND OF TELEGRAPH CABLE.

A COMPANY has recently been formed at Cortaillod, in Switzerland, for the purpose of manufacturing a new kind of telegraph cable, the conductor of which is formed of lead and the insulating material of a resinous or sulphurous substance, the whole being covered by a lead tube.

In spite of the slight flexibility of the insulating substance the new form of cable is very pliant, being by no means inferior in this respect to other forms; also the conductor rigorously preserves its

central position in spite of any bends which may be made in the cable.

In a recent number of the *Journal Télégraphique*, M. Rothen has given the results of some tests he has made of this form of cable.

Three specimens of this cable were experimented upon, the two first only differing from one another in their respective diameters, the insulating material being of a resinous nature. The third cable had an insulating dielectric of a sulphurous nature.

The lengths, weights, &c., of the cables were as follows :—

	No. 1 cable.	No. 2 cable.	No. 3 cable.
Length	Metres. 90	Metres. 110	Metres. 100
Diameter of conductor	Millimetres. 1·43	Millimetres. 1·7	Millimetres. 1·7
Exterior diameter of dielectric	2·9	3·7	3·9
Exterior diameter of protecting lead tube	4·8	5·9	6·3
Weight of 100 metres of cable	Kilogrammes. 13·8	Kilogrammes. 20·5	Kilogrammes. 20·9

The cables before being tested were immersed in water for 5 days.

As a standard of comparison a gutta-percha covered copper wire 100 metres long was taken, the diameter of the conductor being 1·4 millimetres and the diameter of the dielectric 4·3 millimetres.

The tests were made with a battery of 150 Daniell cells.

The first tests made were for inductive capacity, the results being as follows :—

	No. 1 cable.	No. 2 cable.	No. 3 cable.
Capacity in microfarads per 100 metres ...	·0184	·0162	·0232

The capacity of the gutta-percha wire per 100 metres was ·0237 microfarads.

The insulation resistances of the cables measured by the ordinary deflection method were as follows:—

	No. 1 cable. Megs	No. 2 cable. Megs.	No. 3 cable. Megs.
Insulation resistance in Siemens' units per 100 meters ...	133,164	162,756	143,028

The resistance of a similar length of the gutta-percha wire was 93,708 megs., the temperature of the tank in which the cables were immersed being 19° C.

The conductor tests gave the following results :—

	No. 1 cable.	No. 2 cable.	No. 3 cable.
Resistance of conductor in Siemens' units per 100 metres.	12·17	7·49	8·21
Temperatures	10·5° C.	9·5° C.	9·5° C.

The resistance of the copper conductor of the gutta-percha covered wire per 100 metres at 19·5° C. was found to be ·97.

If we compare these results by allowing for the varying diameters of the cables we get the following :—

	Insulation resistance.	Inductive capacity.	Conductivity.
Gutta-percha cable with upper conductor.	1·000	1·000	10·000
No. 1 cable	1·987	·558	·998
No. 2 „	2·208	·540	1·147
No. 3 „	1·817	·826	1·047

These results show that the three cables have an average specific insulation resistance of about double that of gutta-percha, whilst the specific inductive capacity of cables 1 and 2 is rather more than one-half that of gutta-percha. The conductivity of the conductor is extremely low, being only about $\frac{1}{10}$th that of copper.

FULLER'S ELECTRIC LIGHT.

A THIRD lamp for household use has been invented within the last year and nearly perfected. One of the early friends and associates of Edison was a young man, named J. B. Fuller, a Connecticut Yankee, in whom the inventive faculty was active from boyhood. Fuller made a great deal of telegraph machinery and invented many industrial processes, such as modes of utilising wood pulp in paper-making, &c. Ten or fifteen years ago Fuller separated from Edison because it would no longer do to have them work in company. The inventions of the one might easily have been said to be due to the suggestions of the other, and so the two men parted, never to see each other again. They were men of very different qualities, Edison being quick to seize upon a new thought in natural science and apply it to practical use long before any one else could see its practical value, while Fuller loved deep problems and research, and was much more gifted in the work of discovering new principles than in applying them. He was an eager student and a desperate worker, and he succeeded in mastering so many of the mathematical and other problems connected with electrical science that he became the greatest authority thereon, particularly on magnetic induction, in this country. Fuller took up the subject of the electric light in 1874, and has been studying it, in an obscure laboratory in Brooklyn, until the present year. He found at the outset, like so many other men, that there was need of a good magneto-electric machine. He invented his own, based on the principle of Gramme's, and produced so powerful a one, that three years ago he succeeded in having it adopted by the Stock and Gold Telegraph Company of this city for practical telegraphy. The company named has over a thousand machines in different parts of the city, upon which are printed every few minutes the quotations of stocks in Wall Street through the business hours of the day. The Fuller magneto-electric machine was adopted to operate the wire connecting with these stock and gold indicators. Fuller has studied ever since to improve his generator; but when he had once obtained a generator of reasonable power, he returned to experiments with a lamp. He shunned publicity, and in the obscurity of his little shop he toiled for years over his lamp. He was the man best fitted in the United States to attempt a solution of the problem. This inventor evolved a whole system of lighting—the generator, a lamp, and a meter. He proposed to use two large street mains, one of them insulated, disconnected at the outward ends. The positive main was to throw off a branch wire into each building to be

lighted, the wire entering the meter, performing a certain service there, and then returning to the street to the negative main. The main current was not to do the lighting, but it was to generate another current in a series of induction coils, and each lamp was to be lighted by the current from one of these coils. An alternating current was to be used. The induction coils were thus made:—Two magnet cores, arranged parallel to each other, were connected magnetically at the ends. Around the centres of each of these cores was a soft iron head, and at a proper distance from this a head of insulating material. The outward ends of the cores were coiled with insulated copper wire, and so connected together and to the main wire (or generator) as to produce two opposite magnetic poles. Between the soft iron heads and the coils were wound smaller coils of insulated wire, the fineness of which would depend on the tension required. To one of the iron heads was hinged an iron arm, so made as to swing over upon the other, connecting magnetically the poles N. and S. In a coil so made, if a current be sent through the main wire rapidly changing in opposite directions, the magnetic cores will change polarity and the change will induce a current of great tension in the smaller coils, and this second current, if conducted by proper wires to a lamp, will maintain platinum or carbon in a high state of incandescence. Two induction coils, or four, can be coupled together for lights of stronger power. A graduated switch is used in this lamp, so as to permit its brightness to be varied at will. A great many experiments were made with this style of lamp with platinum burners, and they operated admirably. A number of capitalists of Brooklyn, hearing about these experiments, organised a company with 1,000,000 dollars capital last December to adopt Fuller's inventions and introduce his light throughout Brooklyn. A new shop was fitted up for the inventor on Broadway, near 36th Street, in New York City, near his residence, and in this shop Fuller toiled for six months almost literally day and night. His whole system was in a most promising shape, when last February an incident occurred which put a stop to the progress of experiments in household lighting.

The company had determined to manufacture point-to-point lamps and magneto-electric machines first for factory use. About twenty factories in New England and the Eastern states have this winter introduced the large electric lamps of from 700 to 2,000 candle-power into their work-rooms, and the demand for the means of lighting had suddenly become very active. The Fuller Company resolved, therefore, to solicit orders from factories, and it had 75 machines constructed, which are being finished up this week for factory use. During the first week of February Mr. Fuller was engaged in perfecting a new point-to-point lamp and began to be troubled with insomnia. Against the advice of his friends, he worked on his new lamp until it was finished. In the act of tightening up the last screw he fainted and fell to the floor of his shop entirely exhausted, completely worn out with intense mental application and lack of sleep. He was carried to his residence. A week afterwards he had recovered so as to be active again. His busy mind had, in the meantime, discovered a new idea in induction. He sent over to the shop for his man George, the foreman of the works, to explain to him the new idea. The two men sat down together, and Mr. Fuller described his idea with much minuteness—the shape of the magnets, the size of the wire, the manner in which the wire was to be coiled on, and so on, motioning with his hands to illustrate his meaning. When Mr. Fuller had finished, he said, "George, do you understand that?" His foreman replied that he did. "Now," said Mr. Fuller, "I want you to understand that, George, for it is very important;" and then he went over the matter again, explaining the whole idea, with the mathematical principles involved in it. When he had completed the explanation the second time, he said, "Now, George, do you think you understand that?" The foreman said he did perfectly. Mr. Fuller looked pleased, lay back in his chair, and died soon afterwards. This was on the 15th of February. The inventor's life had flickered out, quietly, but unexpectedly to both men, and Mr. Fuller, as every one who is acquainted with his plans believes, has departed just at the moment when he was about to become famous and rich. His foreman was of too practical a turn of mind to see the poetic aspect of such an incident, and it is only within a day or two that the facts have been privately obtained by the writer.—*The Times*, Mar. 22.

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

A NEW DUPLEX SYSTEM.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—With reference to your footnote to my letter, in your edition for March 15th, 1878, respecting the "Moveable Coil," this appeared to me to be a necessity, rather than a "feature," for purposes of adjustment, balancing, &c. (The system depending more upon the method of *dividing the coils*.)

I purposed making one of the coils into a kind of rheostat to effect this object, but as I received no encouragement to proceed with the experiment, I concluded that the "differential system" was preferred.

I need not comment upon Mr. Banker's battery or other arrangements.

E. A. TURNER.

Liverpool, *March* 21, 1878.

F.—We are unable to say whether the key you refer to is similar to your own, as the patent specification contains no further particulars than those given in our extract.

SCHUCKERT'S DYNAMO-ELECTRIC MACHINE.

THE improvement, introduced by Mr. S. Schuckert, consists in the construction of dynamo-electric machines with the most advantageous arrangement for utilising the induction wire or conductor on the revolving iron armature so as to reduce the warming of it to a minimum.

For this purpose the armature is made flat, and composed of several sheet-iron discs. Both side faces as well as the outside are brought under the influence of the magnetic poles, and these poles are arranged with their highest intensity of magnetism directly opposite the side faces of the ring.

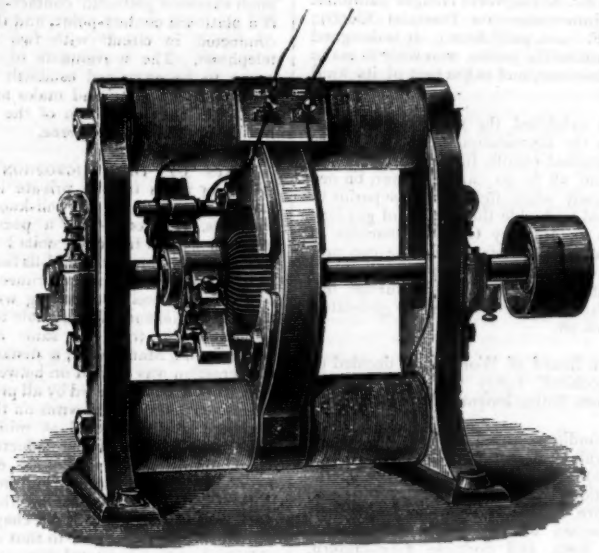
The flat ring is made out of a number of sheet-iron discs, which are magnetically insulated from each other, which serve to save power and prevent over warming of the ring during working; because in these single sheet-iron rings of small volume, the pole changing goes on with little resistance, and the residual magnetism is easily destroyed. The warming

is also prevented by the constant contact of a large portion of the ring with the outside air.

The electro-magnets face the ring with their curved pole plates, forming the two north and south poles, and cover over two-thirds of the whole surface, making opposite polarity in the ring, which becomes

The induced currrents in one half of the ring are in one direction, and those in the other half in the other.

The generated currents on the upper part of the ring, above the neutral line are opposite to those generated below that line, and would neutralise each



SCHUCKERT'S MACHINE.

a south pole before the north pole, and a north in front of the south. They form magnetic fields of high intensity through which the copper wire, or any other good conductor wound about the iron ring is moved during the action of the machine, whereby electricity is induced in the said conductor.

other. To prevent this and utilise them, they are collected near the neutral points by metallic brushes, touching the axle, on which there are a number of insulated metallic pieces, each one connected with a conducting wire coming from the revolving armature.

Notes.

THE ELECTRIC LIGHT.—Colonel Haywood, the Engineer to the City Commissioners of Sewers, has reported on the recent experiment in lighting the Holborn Viaduct by electricity. He states that the total cost of the experiment up to the 18th of February (64 nights) was £785. The sixteen electric lamps were lighted from sunset to midnight at a charge of £5 per night, averaging seven hours. The cost per lamp per hour was over 10d. A gas lamp on the Viaduct, including lighting, extinguishing, and cleaning, cost £4 17s. 6d. per annum. It was alight 4,300 hours annually, and the cost of each lamp per hour was but little over one farthing. The cost, therefore, of lighting the whole Viaduct during the winter months by electricity would be 14s. 3½d. per hour, and by gas 1s. 11½d. per hour, or by night of fourteen hours' duration, £10 by electricity and £1 7s. 1½d. by gas. Applying these rates to a whole year, electric lighting would cost about £3,072 and gas lighting £419. Electric lighting at these charges was, therefore, about 7½ times as dear as gas lighting. As to illuminating power, Colonel Haywood estimates approximately that it is about seven times that of gas.

LIGHT BY INCANDESCENCE.—In our Spanish contemporary, the *Cronica Cientifica*, M. Alf. Niaudet expresses a very decided conviction that carbon, and not platinum or any other metal, is the best material for the production of the electric light by means of incandescence. In support of this position, M. Niaudet adduces the following arguments: 1. At equal temperatures, carbon possesses a power of radiation in excess of that of platinum. 2. The heat capacity of platinum is far greater than that of carbon, and the former, consequently, requires a far greater amount of heat than the latter to bring it to a given temperature. 3. Carbon is a worse conductor of electricity than platinum, and, consequently, may be of greater diameter without the temperature being reduced. 4. Carbon is absolutely infusible, and may be brought to a white heat without the circuit being interrupted owing to fusion.

TEMPERING THE ELECTRIC LIGHT.—It has occurred to a Frenchman that as clouds temper the brightness of the sun, so an imitation of clouds, by wadding made of glass fibre, would temper the electric light; and by using screens of glass wadding instead of opaline or clouded shades he reduces the loss of light from 50 to 25 per cent.

WE have received Mr. Killingworth Hedges' pamphlet entitled "Useful Information on Practical Electric Lighting." (E. and F. Spon, publishers.) It is designed as a guide to the unscientific public, who wish to make use of the new illuminator, and is the best of its kind we have seen.

MR. EDISON has exhibited the working of his incandescent light in the illumination of his laboratory and factory with excellent results, furnishing 14 of the new lamps, each from 18 to 20 candle power, on one circuit, giving a steady white light, much superior to the carbon, and equal to double the number of gas jets. The generator was an ordinary Gramme machine of 2½-horse power. Mr. Edison states that he can now supply light for practical domestic use at less than half the cost of gas, but is experimenting for further improvements in the lamp and economy in the generator. —*Daily News*, March 28.

THE Metropolitan Board of Works have decided to continue the Jablochkoff lights for three months longer on the Thames Embankment, at a reduced cost.

JABLOCHKOFF'S candle was tried on March 13, in the theatre of the Royal United Service Institution, as a means of illumination for facilitating surgical operations and examinations in dull weather or after dark. Mr. Balmonno Squire, Senior Surgeon to the British Hospital for Diseases of the Skin, exhibited a remarkably small, light, and portable hand-lantern, containing in a tube projecting from the back of it (which tube served also as a handle for the lantern) a Jablochkoff candle. By means of a screw contrivance fitted in the tube the burning end of the electric candle could be advanced forward into the lantern as the candle gradually burnt back. This, with two connecting screws for attaching the electric wires, formed the whole of the apparatus. A minute window formed of dark-blue glass placed at the side of the lantern formed the means of ascertaining from time to time the exact position of the burning end of the electric candle. He advocated its use as a means of affording a powerful and steady light in the dark cock-pit of ships of war. He also advocated the use of his electric lantern for similar reasons in military field-hospitals, where the same conditions present themselves during a night encounter, and pointed out that, while for military purposes the necessary electric and steam engine conveyed on the same carriage would be far lighter than an ordinary piece of field artillery, yet for naval purposes the requisite steam power was always on board, and on most war-ships the necessary dynamo-electrical machine was already in use for electrical illumination against torpedo practice. The force required to generate the light he placed at only one and a half horse-power, and the cost of the apparatus £100.

THE TELEPHONE.—Mr. Elisha Gray's patent for telephones granted on July 27, 1875, has been extended by the U.S. Patent Office. This patent is worked by the American Speaking Telephone Company, and, as is well known, the owners maintain that it covers the Bell telephone, a claim which, we apprehend, no unprejudiced expert will allow.

THE SPHYGMOPHONE is the name given to a patented contrivance for rendering the beating of the pulse or the heart audible to a roomful of people by its inventor, Dr. S. Th. Stein, of Frankfort. The apparatus consists of a piece of watch spring, five centimetres long, which is soldered to a small brass frame, and is provided at its free end with a gutta percha knob. This small knob is placed against that part of the human body whose movements are to be made audible. The knob carries a platinum contact-plate, opposite which is a platinum contact-point, and these two contacts are connected in circuit with two Bunsen cells and a telephone. The movements of the pulse, or other organ to be examined establish contact between the point and the plate and make and break the circuit. Hence the natural rhythm of the pulse or the heart is heard aloud in the telephone.

FEATS OF THE MICROPHONE.—We extract the following items from a private letter written by Mr. Louis J. Crossley, of the well-known firm of Crossley Brothers, Halifax:—"By a peculiar arrangement of microphone and induction coils I exhibited in a large room at our Dean Clough Mills Institute, to an audience of over 500 persons, an experiment in which the music of a cornet as well as speaking was transmitted a distance of a mile and made audible to the entire audience.

I have also tried the same arrangement between Halifax and Manchester, a distance of 34 miles, and conversation was carried on between the two places so that it could be well heard by all present in the respective offices. There were 22 wires on the poles and the experiment was conducted at midday, when the wires were busiest, so that the induction sounds from the neighbouring wires were loud enough to be clearly heard at a short distance from the receiving telephone.

For some months past we have got every word spoken from the pulpit of our chapel on Sundays transmitted to my house, and to that of an invalid lady residing close to me, a total distance of about three miles.

MR. LATIMER CLARK has issued an address to the President and Council of the Society of Telegraph Engineers, suggesting wider scope for the Society.

MR. SCUDAMORE has gone to Beyrouth at the request of Midhat Pasha.

AN ELECTRIC BORER.—M. Gaston Planté has published his important researches on electricity and the electric discharge in an octavo volume dedicated to the Emperor of Brazil. From a copy of these very interesting studies now before us, we extract the following passage relative to the boring power of the electric spark:—"We have seen that one of the electrodes which conveys a current of a certain electromotive force on being put in contact with glass, in presence of a saline solution, acts as a graver or a diamond in cutting furrows on the surface of the glass, ploughing it even deeply. Rock-crystal can also be attacked, despite its hardness, by the same method, and if it does not yield regularly it at least bursts into pieces under the influence of the electrode, and ends by breaking up. In America black diamonds are employed in rock drilling for wells and mines. Could these expensive tools not be replaced by the action of the electric current in conditions analogous to those which have been described, and the perforation of rocks be performed by electricity? Electrodes of platinum would not be necessary, for it is not the metal of the electrode which alters, but merely the silicious matter in presence of the saline solution. Metallic points or studs conveniently distributed at the end of the drill and put in rotation would direct the electric discharge to the rock, which it would pulverise as in the case of the diamond drill. The recent advances

in the production of electricity by mechanical means would facilitate this application."

THE VOLTAIC PENCIL.—Bellet's voltaic pencil, which has been patented in England in the names of Louis Bellet and Count Hallez D'Arros, founder of *L'Electricite*, was exhibited, along with some of its work, at the Scientific Soirée given by Admiral Monchez, at Paris, on Feb. 21. These works comprised engravings on copper, steel, and stone, executed at first hand by the spark from the pencil point, and electro-stencils or copies of documents and drawings. It is believed that this electric graver and pencil will be useful in military topography.

While in Paris General Grant had his portrait taken by the light of Jablochkoff's electric candle. This is a case in which the artist could not happily apply the proverb, "Le jeu n'en vaut pas la chandelle."

MESSRS. CROSBY LOCKWOOD & Co. are about to issue a revised edition of Dr. Noad's work on Electricity, with an introduction and additional chapters by Mr. W. H. Preece.

CLERAC'S TUBE.—Professor Barrett has kindly sent us a copy of his lecture on Mr. Edison and his Work, which is now published as one of the science lectures for the people, and a very interesting one it will form. It is right that one who addresses the people on matters of science should render scrupulous justice to the merits of discoverers and inventors, for the subject is one on which the people cannot judge for themselves, and must implicitly trust their teachers. We are therefore gratified to find that Clerac's tube is referred to by Prof. Barrett in the printed pamphlet as follows:—"It has been said that a French electrician, M. Clerac, discovered this property, and made an instrument such as I have described, some twelve years ago. In fact Prof. Hughes, whose name is well known in connection with his invention of the printing telegraph and the discovery of the microphone, writes to me that since 1866 he has had in his possession a resistance tube made by Clerac, in which plumbago, more or less compressed by a screw, was employed, and the resistance made to vary by pressure. This tube has been seen by many. It is known that Clerac used squeezed plumbago as a stated resistance, but I can find no *record* of its being used as a *variable* resistance. Nevertheless, eminent eye-witnesses declare such was the case, and I do not doubt their statement, though this does not amount to publication in the scientific sense. Edison certainly independently re-discovered and greatly increased the importance of the effect of pressure on carbon dust. The only person who previously to Edison seems to have noticed that pressure made any difference in conductivity was a well-known electrician, the Count du Moncel, who, twenty years ago, pointed out this fact as a curious property most marked in semi-conductors. This incidental observation was, I believe, forgotten till, in 1873, Edison re-discovered and greatly extended it. I refer to this particularly, as considerable discussion and much misunderstanding has arisen therefrom, a misunderstanding which led Edison to use hasty expressions which, though deplorable, were natural enough to a man who considered himself grievously wronged; but the ground of offence would never have occurred had a better understanding existed on both sides."

SPEED OF A SIGNAL.—Recent experiments prove that a signal sent over the land-line from Paris to Marseilles, a distance of 525 miles, takes 0·024 sec. to travel, whereas a signal sent through the Marseilles-Algiers cable, a length of 574 miles, takes 0·233 sec.

BLASTING POST HOLES.—According to the *Scientific American*, telegraph post holes are blasted out in Pennsylvania by a man driving a crow bar four or five feet into the ground, then dropping in a cartridge and a lighted fuse. Before he reaches the site of the next pole the cartridge explodes, making a pit as large as a flour barrel. In this way four men will set up 100 to 150 poles a day.

GARY'S MAGNETIC MOTOR.—A rival to the Hosmer motor has appeared in America. It is said to be based on the discovery of a neutral line in the magnetic field of a horse-shoe magnet in front and on either side of the holes. A piece of soft iron in this neutral position appears to have no polarity, but the slightest change of position to one or other side of this line produces positive or negative polarity in it. Mr. Gary, we believe, claims to get unlimited power without expenditure of fuel by taking advantage of this property of the field. If so we fear that Mr. Gary will experience a disappointment.

FIELD TELEGRAPHS.—Lord Chelmsford has asked for a field telegraph to be sent out to him; also electric lights for his encampments. The Ordnance Department at Woolwich have accordingly forwarded a fully equipped wire-waggon-and-barrow apparatus to the *Loanda*, now taking in cargo at the Royal Arsenal. The waggon consists of a strong but simple framework on ordinary wheels, supporting on revolving spindles six drums or reels of telegraphic wire, the movement of a lever and clutch causing the vehicle either to lay or pick up the wire as it passes over the ground. The barrow carries a single drum, and is mounted on wheels only 2 ft. high, with a 2 ft. track. It resembles an ordinary hose-reel, and is so light that it can be run over the field by one or two men, and can, therefore be of use during an action. Each drum carries 133 lbs. of wire. The waggon carries telegraph poles, a ladder and tools for constructing an "air line." The poles consist of iron tubes, in lengths of about ten feet, uniting by a bayonet joint and secured by three guy lines. A few sets of electric lighting apparatus and portable engines will also be sent out. The force under his command does not seem even to have been provided with Mance heliographs.

A CABLE JUBILEE.—We learn from the *Scientific American* that Mr. Cyrus W. Field gave a grand dinner party on March 10, in celebration of the twenty-fifth anniversary of the formation of the Company of New York Merchants which helped to lay the first Atlantic cable. Of these gentlemen only one has since died, namely, Mr. Chandler White.

AT the International Meteorological Congress which will meet in Rome on April 14, the project of establishing an Arctic observatory at Wilzeck, in Nova Zembla, will be discussed. Electric and magnetic observations form an important part of the scheme of work which has been devised by Messrs. Weyprecht and Payer.

A MEETING is to be held in New York on April 30 to arrange for an International Exhibition at New York, in 1889, the centennial of the anniversary of the Union of the States. Dr. Norvin Green, President of the Western Union Telegraph Company, is one of the Executive Committee. This is taking time by the forelock, but the occasion is a great one, and the Exhibition will be so also, provided the world doesn't come to an end meanwhile, and the United States be disunited into infinite azure.

IN the United States Senate, on Monday, Feb. 24, Mr. Hamlin, from the Committee on Foreign Relations, reported adversely on the Senate bill to grant to the American Ocean Cable and Telegraph Land Wire Association of Philadelphia the right of way and privilege to lay, land, and operate submarine cables on the Atlantic and Pacific coasts of the United States, and establish telegraphic communication between the United States, Europe, and Asia, and it was indefinitely postponed.—*Journal of the Telegraph*, U.S.

TWO men were executed at Mauch Chunk, Pa., on Jan. 14, and immediately after the drop had fallen a telegraphic reprieve arrived from the Governor, but was just about half a minute too late.—*The Operator*, U.S.

New Patents—1879.

876. "Mode of and apparatus for producing light by electricity." J. B. SPENCE. Dated March 5.

925. "Electric lamps." K. W. HEDGES. Dated March 8.

926. "Improvements in electro-dynamic and dynamo-electric apparatus, and in the application thereof to effect discontinuous movements in parts of engines and machinery." M. P. W. BOULTON. Dated March 8.

927. "Means employed for producing the electric light." R. C. THOMPSON. Dated March 8.

935. "Improvements in galvanic batteries and in the application thereof to luminous buoys and for other purposes." L. A. BRASSEUR and A. E. DEJAER. Dated March 10.

947. "Apparatus for electric lighting." H. J. HADDAN (communicated by C. F. Brush). Dated March 11.

960. "Dynamo-electric machines." L. SIMON (communicated by S. Schuckert). Dated March 11.

1012. "Mode of obtaining electric lighting." A. L. COKE. Dated March 14.

1015. "Electric batteries applicable to telegraphic and other purposes." T. J. HOWELL. Dated March 14.

1122. "Improvements in the means or apparatus for obtaining light by electricity and in the manufacture of materials to be employed therein. H. G. L. FOX. Dated March 20.

ABSTRACTS OF PUBLISHED SPECIFICATIONS—1878.

2640. "Magnets for separating metallic substances from materials used in the manufacture of pottery." E. LAKE and J. EDWARDS. Dated July 2. 6d. To render magnets incorrodible, so as not to contaminate the materials of the ware, they are covered with enamel or electrotype. The magnets are plate-shaped, and pierced with holes to expose much surface to the glaze or other materials to be cleaned.

2878. "Electric motor." E. J. HARLING. Dated July 18. 4d. A shaft, carrying pairs of radial arms shod with iron armatures at their ends, at different angles to each other, is caused to rotate by the attraction of properly exerted electro-magnets on the iron armatures. (Void by reason of the patentee having neglected to file a specification, in pursuance of the conditions of the Letters Patent.)

3011. "Rheophores, commutators, and galvanic batteries." JAMES and JOHN ARNOLD. Dated July 29, 2d. In applying electricity to the body, it is sometimes necessary to change the battery poles connected to the rheophores or electrodes which touch the skin, so as to reverse the current. According to this invention the commutating rheophore is a pole changer and a rheophore combined. They attach for this purpose a cable, composed of two or more wires or conductors to each rheophore, one wire being connected with the positive and the other with the negative pole, so that they can be changed at will. Inside this new rheophore are springs and contact pieces, or "cocks" connected to the aforesaid wires, and by means of a small key or button, the springs are so acted upon as to change the poles. *Not proceeded with.*

3080. "Electric telegraphs." J. W. BROWN. Dated August 3. 2d. This consists in receiving instrument for cables formed of a coil freely suspended in a magnetic field, and fitted with an arm which makes and breaks contact in a local circuit. *Not proceeded with.*

3217. "Transmission of signals by electricity." W. R. LAKE (communicated by Angelo Cattaneo, of Pavia). Dated August 14. 4d. The object of this is to utilise rails as a telegraph line, the right-hand wheels of the cars being insulated from the left-hand ones. *Not proceeded with.*

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AT the ordinary general meeting of this society, held on February 27th, Major Bateman-Champain (President) in the Chair, the discussion on Mr. Willoughby Smith's paper on the "Working of Long Submarine Cables" was continued by Mr. C. F. Varley. A paper was then read by Professor Ayrton, on "A New Method of Determining the Relation between the Electro-magnetic and Electro-static Units." At the conclusion of the paper, Mr. Cowper gave a description of his ingenious "writing telegraph," a description of which appeared in the number of the JOURNAL for March 1.

At the ordinary general meeting of the society, held March 13th, a paper was read by Professor Hughes on "Induction on Air-Telegraph Lines." An account of this paper appeared in our last impression.

PHYSICAL SOCIETY.

AT the meeting on March 22, Prof. W. G. ADAMS, President, in the Chair,

Capt. ABNEY, R.E., F.R.S., read a paper on "Obtaining Photographic Records of Absorption Spectra." Absorption spectra have hitherto been recorded by the difficult method of hand copying; but the discovery, by Capt. Abney, of a silver salt, sensitive to all rays in different degrees, renders the photographic method available. The records thus obtained are photographs of the spectrum of the naked light of the source and of that of the same light reduced by insertion of the absorbing material in its track, and these are taken parallel, so that the dark absorption lines can be readily compared. Examples of these were thrown on the screen. This method can be used as a new weapon in attacking solar physics, and determining whether or not compound bodies exist in the sun. Absorption spectra, to compare with the sun's, can be got for compound bodies by burning the matter in question in

a flame in front of the slit and passing a bright light through the flame.

Prof. GUTHRIE, F.R.S., then read a paper on the "Fracture of Colloids," as illustrated by experiments on the breakage of glass plates, either by pressure or heating at the centre or round the circumference. Circular plates of glass, pressed at centre or circumference, break in radial lines. However supported, a plate breaks in the same fashion if heated in the same way. If heated in the middle, the crack is peak shaped, like an obelisk on a double pedestal, two cracks forming the outline, with sometimes a third down the middle. The two cracks unite before they reach the edge on one side, and (as afterwards pointed out by Prof. W. G. Adams) the three extremities of the two cracks all meet the edge at right angles to it. The crackage varies with the size and shape of the plates, the flame, and kind of glass; but the type is the same for all, cracks cross each other. Prof. Guthrie defined a crack as the line where the ratio of cohesion to strain is least, and likened it to the lightning flash.

Mr. W. CHANDLER ROBERTS, F.R.S., said that he had observed once a volute spiral crack in dried hydrated silicic acid; and recommended Prof. Guthrie to study cracks in agate, which is the most perfect colloid known.

City Notes.

Old Broad Street, March 27th, 1879.

THE DIRECT UNITED STATES CABLE COMPANY.—The half-yearly general meeting of this company was held at the City Terminus Hotel, on Friday the 21st March. Mr. John Pinder, M.P., the chairman, presided, and in moving the adoption of the report, an abstract of which has appeared in *The Times*, after referring to the financial results of the half-year's working, which are given in the report, said the gross earnings, in spite of the general depression in trade, had increased by £5,700, being at the rate of nearly 7 per cent., as compared with the corresponding period of 1877. The total expenses showed a decrease of £3,300, equal to 13 per cent., due, however, principally to the comparison being made with the December half of 1877, in which period they incurred expenditure for repairs. Deducting this item, in order to make the comparison a fair one, the working expenditure had been slightly reduced. It would, however, have been very considerable but for the new charge for duplex royalty, which did not appear in the accounts of 1877. He then alluded with regret to the obstruction which the present Board had met with from interested parties, and said this had continued until the other day, when the arbitration was closed by the delivery of the award. The money for obtaining this must all come out of the shareholders' pockets, and it had been literally thrown away, for the award amounted to about what the liquidator offered to the dissentient shareholders—namely, £13 per share, but with interest, say £15. The dissentient shareholder put forward in his claim as the value of his interest the sum of £76,143—that was, he took his shares as worth £76 each, the par value being £20. The actual amount awarded to him was £15,000, or £15 per share. The expenses of the arbitration would not be far short of £10,000. They had heard lately of the attempt to get up an opposition company in France. The same parties, assisted by a French combination, were, he said, what he might term the promoters of this scheme. It had astonished him to find that French companies such as those who were taking an interest in this scheme should have looked so little into facts and figures. He had been to Paris accompanied by other gentlemen interested in Atlantic submarine telegraphy, and they had interviewed the leading men connected with those financial companies. He told those gentlemen that the Direct Company had many advantages in its greater security from its connexion with the the Anglo-American Company, and that in every sense it was a much more valuable property than their new cable could be, but that the shares of the Direct Company, at the time he was speaking to them, were at a discount of close upon 50 per cent. He pointed out that the company, if brought out, must of necessity come down to the same level, and that if they persisted in their scheme after this information the moment their cable was laid competition would arise—that a shilling, or probably a sixpenny tariff, must be adopted, and although there would be a diminution in this company's receipts, it would entirely prevent the new company from paying one shilling to their shareholders, and the result this company would look forward to would be that they would in time, if they chose, become possessed of the new cable at 30 or 35 per cent. of its cost. He pointed out to them that there was no necessity whatever for a new cable, seeing that the existing cables were equal to three or four times the amount of work now offered, and seeing that since the Anglo and Direct Companies had both applied the duplex principle, their carrying power had been very greatly increased. The result of the visit, which was three months ago, was no doubt to open the eyes of the financiers, who were still wisely hesitating. He was told that the *amour propre* of the French people must be satisfied, that the whole of this great telegraph enterprise centred in England, and that France should share it, although France contributed only about 11 per cent. of Atlantic traffic. He had always held that submarine telegraphy should have an international character, and with that view and in order to meet the French susceptibility, the Atlantic companies were prepared to establish a company in France, with a French representation, using the Brest cable for the scheme to work in harmony with the existing systems. The promoters of the new scheme said they had got a concession from the French Government. It had been stated that the head of the combination was to receive £20,000 for this concession with a permanent position as president of the company. He also understood that the gentleman who was to manage the company was to secure for himself a remunerative position, and that the financiers who were said to be backing it up were to receive a very large amount of money other than what was required for the construction of the cables. As to the concession, he might mention that there was already a concession from the French Government held by the Anglo Company, which gave them very important advantages, with a preference of all the French traffic, and this concession had still eleven years to run. He was anxious to obtain a sight of the new concession. He applied at the Government offices, but found for some reason, although one of the leading Ministers told him he saw no reason why a copy of it should not be given them, up to that moment they had not received a copy of it. He was told, however, by the same French Minister that it was merely a landing right, and that the French Government would be prepared to give such a concession to any respectable company who might ask for it. As to the amount of promotion money, so far as he could learn, the two cables for which they were asking subscriptions for over £2,000,000 might be contracted for that day for about

£1,600,000, including the cost of laying; but, allowing £100,000 for contingencies, there was between £400,000 and £500,000 for the necessity of which it was very difficult to account. He was yet hopeful that this scheme would fail like its predecessor. As to their relations with governments and companies on the other side of the Atlantic, so far they had had no difficulty. They hoped to have their position definitely recognised in Canada during the present Parliament. They were about to issue £100,000 of 5 per cent. debentures, which would be offered to the shareholders *pro rata*. The £100,000 would be applied in recouping the 7 per cent. debentures they had paid off—to the extent of £17,000, and in paying off the dissentient shareholders. On the previous night they received a telegram informing them that their main cable was repaired, that their traffic was going on as usual, and that the ship had gone to repair the shorter section. He might remind them that, notwithstanding that they had these interruptions, their revenue was not affected, owing to their arrangements with the Anglo-American Company. That was one of the very important features in submarine telegraphy—that one cable was uncertain, perhaps, while two or three constituted a valuable and secure property. Mr. W. Ford having seconded the motion, a brief discussion followed, and in reply to questions the chairman said it was a great economy to work the duplex system. He desired that the working of their system should have an international character, and he disclaimed all idea of a monopoly. They employed their cables during the day at only a fair tariff. In spare time the Press used them at quarter rates, by which the public had an enormous boon conferred on them. The report was then unanimously adopted, and a vote of thanks to the chairman and directors terminated the proceedings.

INDO-EUROPEAN TELEGRAPH COMPANY (Limited).—The report of the directors of this company states, the revenue from all sources for the year 1878 was £85,234 13s. 3d.; the expenses £45,539 7s. 1d. After charging £7,005 15s. 7d. per centage upon profits payable to Messrs. Siemens, under their Maintenance Contract, taking credit for the balance brought over from last year, £2,830 8s. 8d., and deducting income tax, there remains the sum of £35,046 4s. 8d. The directors propose to declare a dividend for the six months of 17s. 6d. per share, making, with the interim dividend already paid, 6 per cent. for the year 1878, free of income-tax. It is proposed to restore £6,000 to the reserve fund, and to carry forward the balance of £939 13s. 5d. The reserve fund will then amount to £12,461 7s. 11d. The meeting is to be held on March 31st.

DIRECT SPANISH TELEGRAPH COMPANY (Limited).—The accounts of this company for the half-year ending 31st December, 1878, show a balance to the credit of Profit and Loss of £3,588 0s. 6d.; traffic receipts £729 5s. 2d. in excess of those for the corresponding period of 1877. After providing for the half-yearly dividend on the preference shares at the rate of 10 per cent. per annum, which it is proposed to pay on the 1st April, there will remain £666 10s. 6d., of which the directors recommend that £623 9s. 3d. be placed to the reserve fund, which will then amount to £1,700, leaving a balance of £43 1s. 3d. to be carried forward. The meeting is called for the 31st March.

EASTERN EXTENSION TELEGRAPH COMPANY.—In the report of the Company, the net profit for the half-year is shown to be £69,726 16s. 6d., making, with £24,323 3s. brought forward, a total of £94,049 19s. 6d. An interim dividend of 1¼ per cent. has been paid for the six months, and it is now proposed to distribute another of like amount, making 5 per cent. for the year. The balance (£44,112 9s. 6d.) has been carried to the reserve fund, which now stands at £75,017 15s. 11d.

The directors of the Brazilian Submarine Telegraph Company have declared an interim dividend of 2s. 6d. per share, or 5 per cent. per annum, free of income tax, for the quarter ended 31st December, 1878, and payable on Tuesday, the 25th inst. The books of this company will be closed from the 18th to the 25th inst., both days inclusive.

At the General Meeting of the Great Northern Telegraph Company to be held at Copenhagen on the 16th April next, it will be proposed that a final dividend of 2s. 9d. per share be declared, thus, including the 5 per cent. interim dividends already paid, making the total dividend for 1878, 6¾ per cent. It will further be proposed to add £44,444 8s. 10d. to the reserve fund which will then, after the years' outgoings, stand at £91,999 13s. 2d., and finally, that £14,837 0s. 11d. be carried forward to next account.

The directors of the Direct United States Cable Company of 1877 have issued forms of application for 1,000 debentures of £100 each, £5 per cent. debentures to enable them to pay off the amounts due to the dissentient shareholders of the company of 1873, and to put the capital account of the company on a firm basis. £5 per cent. payable on application, £20 on allotment, £25 on July 1st next, and £50 on the 1st October next. Restoration of the same company's cable was reported on March 21st.

The directors of the Eastern Extension Telegraph Company (Limited) have declared a dividend for the quarter ending December 31st last of 2s. 6d. per share, making, with the three interim dividends already paid, a total of 5 per cent. for the year 1878. The sum of £44,112 has been carried to the reserve fund, which now stands at £75,017.

The directors of the Anglo-American Telegraph Company (Limited) have resolved (after placing £37,500 to the renewal fund) to declare an interim dividend for the quarter ending the 31st inst. of 1 per cent. on the ordinary stock and of 2 per cent. on the preferred, both free of income-tax, payable on May 1 to the shareholders registered on the books of the company on April 1, leaving a balance of about £9,000 to be carried forward.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 57½-58; Ditto, Preferred, 86½-87½; Ditto, Deferred, 29½-30½; Black Sea, Limited, —; Brazilian Submarine, Limited, 6½-7; Cuba, Limited, 8-8½; Cuba, Limited, 10 per cent. Preference, 15-16; Direct Spanish, Limited, 1½-2; Direct Spanish, 10 per cent. Preference, 10½-11½; Direct United States Cable, Limited, 1877, 11-11½; Eastern, Limited, 7⅞-7¾; Eastern, 6 per cent. Debentures repayable October, 1883, 105-108; Eastern 5 per cent. Debentures repayable August, 1878, 100-103; Eastern, 6 per cent. Preference, 11½-11¾; Eastern Extension, Australasian and China Limited, 7⅞-7¾; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 106-109; German Union Telegraph and Trust, 7¾-8½; Globe Telegraph and Trust, Limited, 4¾-5; Globe, 6 per cent. Preference, 10½-10¾; Great Northern, 8½-8¾; Indo-European, Limited, 21-22; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9¼-9½; Reuter's, Limited 9½-10½; Submarine, 215-225; Submarine Scrip, 1½-2½; West India and Panama, Limited, 1⅛-1¼; Ditto, 6 per cent. First Preference, 8¼-8½; Ditto, ditto, Second Preference, 7½-8¼; Western and Brazilian, Limited, 3¾-4¼; Ditto, 6 per cent. Debentures "A," 93-97, Ditto, ditto, ditto, "B," 87-92; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 114-118; Ditto, 6 per cent. Sterling Bonds, 101-103; Telegraph Construction and Maintenance, Limited, 29¼-29½; Ditto, 6 per cent. Bonds, —; Ditto, Second Bonus Trust Certificates, 2½-2¾; India Rubber Co., 10¼-10⅝.